



# TTM 01-E



# User Manual

**1<sup>st</sup> Revision**

This document supports all TTM 01-E with firmware revision V1.000



*When you need to be certain*

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# **TTM 01-E**

## **User Manual**

**1<sup>st</sup> Edition**  
September 2009

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### **Revision History:**

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## 1. INTRODUCTION

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Congratulations on your purchase of TTM 01-E – Tekron's powerful and cost effective synchronization solution for RTUs, Protection Relays and other Intelligent Electronic Devices (IEDs) used in electrical substations and industrial control installations.

Utilizing state of the art technology and a timing optimized snow-resistant antenna, these compact units lock onto atomic clock references from the GPS satellite constellation and produce time codes and pulses with sub-microsecond accuracy and precision.

TTM 01-E's rugged design is suitable for noisy electrical environments, while built in electrical isolation combined with strong push pull drives on all outputs simplify wiring schemes and enhance reliability.

TTM 01-E clips onto a standard DIN rail. Windows™ software and Ethernet connectivity make customization and setup a breeze.

TTM 01-E comes complete with all components required for installation, including low loss antenna cable, antenna pipe mounting components, configuration software and cable, and optional lightning protection kit.



## 2.LED INDICATORS

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The top of the TTM 01-E features two LED indicators. The GPS LED shows the status of the internal GPS receiver, while the SYN LED shows sync status of the unit.

Outputs are synchronized to UTC time only when the SYN LED is illuminated (on).

Table 1 below provides information regarding the interpretation of the LEDs.

GPS LED	SYN LED	Meaning
••••      •••• 4 flashes /sec	OFF	Antenna fault; The antenna or antenna cable is either disconnected or faulty, or there is a short circuit somewhere.
••      •• 2 flashes /sec	OFF	The antenna is good, TTM 01-E is searching the sky for satellites; but is not in sync to UTC time.
—      — 1 flash /sec (long on)	— ON	TTM 01-E outputs are accurate to within 200ns of UTC time, and therefore useable for sync purposes.

Table 1

Refer to section 3.2 for information regarding the interpretation of the LNK LED.

## 3.INPUTS AND OUTPUTS

### 3.1. Antenna connector (SMA connector)

The “ant” antenna input provides an interface for an external active antenna via low-loss coaxial cable, 50 Ω impedance. 5 V DC @ 50 mA max is supplied to power an active antenna. The total combined gain of the antenna system (antenna plus cable and connectors) should fall in the range of 10 to 35 dB, the optimum being 22 dB.



TTM 01-E is normally supplied complete with a timing-optimized narrow-band antenna and 30 m of lead-in cable, this combination provides an overall gain near the optimum of 22 dB. For lead-in lengths longer than 60 m, amplification and/or larger diameter, lower loss cable can be supplied to order.

**■** Care should be taken to ensure that the connector is not cross-threaded when attaching the antenna lead-in cable. The connector should be tightened firmly by hand only. Do NOT over-tighten.

A Lightning Protection device may be inserted into the antenna lead. A suitable device complete with additional cable connectors, a connector crimping tool and mounting hardware is available as an option (see section 7.2 for details). Use of a Lightning Protector does not degrade the performance of the antenna system.

### 3.2. Ethernet Port (RJ45 connector)

TTM 01-E units are fitted with an RJ45 Ethernet interface. This allows the unit to be configured over a LAN (Local Area Network) switch or by direct connection using an Ethernet cross over cable. The TTM 01-E can be ordered with, or upgraded to, output NTP/SNTP and also PTP via the Ethernet interface. The interface supports 10/100 Mbps connectivity.

To the left of the antenna SMA connector is a green LED labeled “LNK” which provides information on the status of the Ethernet port.

Table 2 below provides information regarding the interpretation of the LEDs.

LNK LED	Description
OFF	Ethernet cable is not connected or a fault has been detected
—	Ethernet cable is connected
— — — Rapid Flashing	Ethernet connectivity – Packets are being detected

Table 2

### 3.3. Sync Indication Output

The sync indication output reflects the state of sync. Sync indication, is via an opto-isolator switch, rated at 200 V and 150 mA. When the unit is in sync with UTC time, the opto-isolator switch is on. Figure 1 and Figure 2 below show wiring examples.

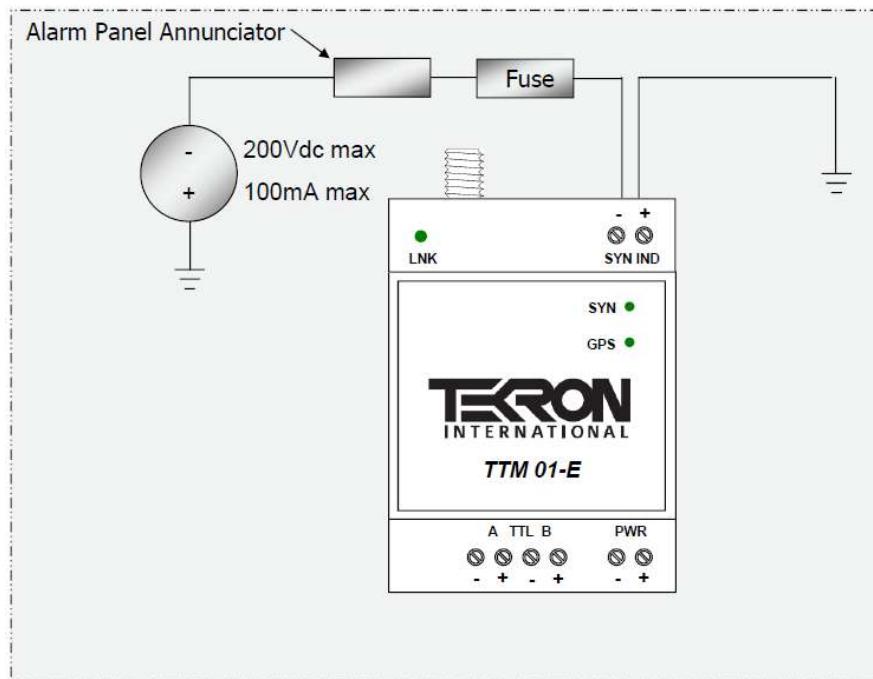


Figure 1 – Positive earth connection diagram

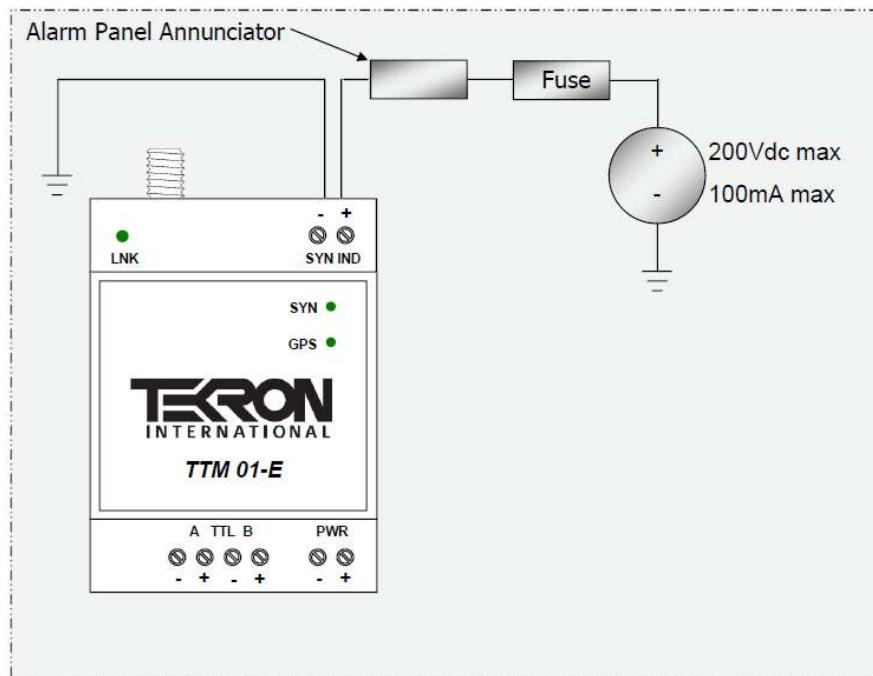


Figure 2 – Negative earth connection diagram

### 3.4. Output options

TTM 01-E has three main variants: TTL, Serial and AM IRIG-B. In addition to the outputs available on these variants, the TTM 01-E can be ordered with NTP/SNTP or with NTP/SNTP and PTP output options.

Table 3 below shows the main variants and orderable options.

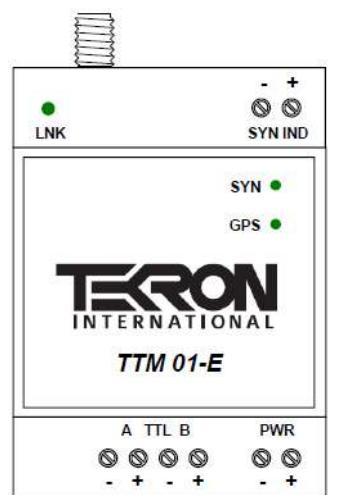
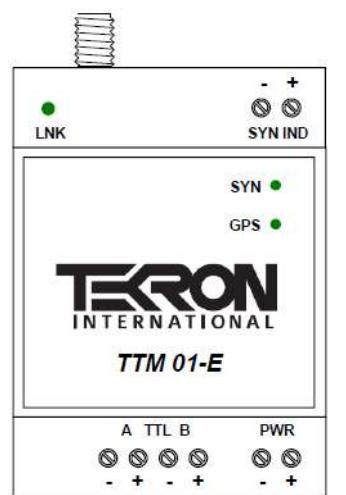
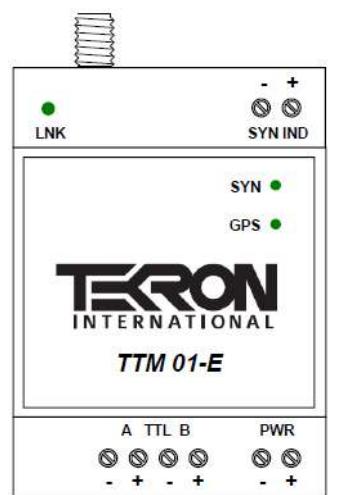
Version	Number of serial output strings 9600 bd.	Number of user defined pulses or time codes (DCF-77, DC IRIG-B00X, DC IRIG-B22X)	Number of AM IRIG-B (B12X) outputs:	NTP/SNTP and PTP
TTL (T2-Txxx)	none	2	none	1 (Optional)
Serial (T2-Sxxx)	1	1	none	1 (Optional)
AM IRIG-B (T2-Axxx)	none	none	1	1 (Optional)

Table 3

#### 3.4.1. TTL (order code: T2-Txxx)

CMOS/TTL (5V) driven (150 mA push-pull).

Each port is fully floating and isolated.

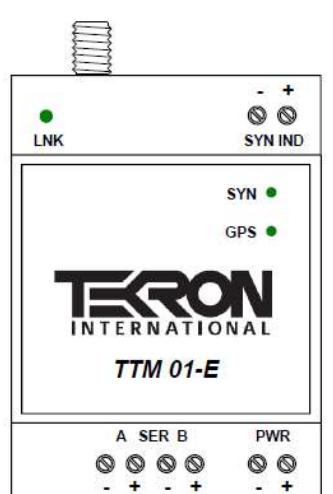
Output Type		
TTL A	Digital pulses or  Time codes: IRIG-B (B020, B021, B022, B023, B220, B221, B222, B223), DCF-77	
TTL B	Digital pulses or  Time codes: IRIG-B (B020, B021, B022, B023, B220, B221, B222, B223), DCF-77	
	Each output is user programmable. A typical application will have one output programmed for IRIG-B and the other for 1 PPS	

### 3.4.2. Serial (order code: T2-Sxxx)

RS232 level (+/- 9 V) signaling.

The RS232 signals A and B are not HV-isolated from each other in that they share a common earth, but the port as a whole is isolated.

Output Type	
SER A	Digital pulses or  Time codes: IRIG-B (B020, B021, B022, B023, B220, B221, B222, B223), DCF-77
SER B	Serial time messages at 9600 baud
	Each output is user programmable. A typical application has String-C on "SER B" output and 1PPS on "SER A"  Appendix B on page 35 describes the message strings programmable for output on "SER B".



### 3.4.3. AM IRIG-B (order code: T2-Axxx)

Provides amplitude modulated IRIG-B output (B12x).

Use either coaxial cable or shielded twisted pair, to feed this signal to any connected IED.

The output is fully floating and is transformer-isolated.

Output Type	
AM IRIG-B	Amplitude modulated IRIG-B  The output is user programmable for: IRIG-B120, B121, B122 or B123.  The AM IRIG-B output can drive many devices in parallel (multi-drop). In all cases a terminating resistor must be fitted at the far end of the cable.  The terminating resistor value range is from 100 ohms (few loads) to 180 ohms (many loads). 1W resistors are recommended.



## 4. INSTALLATION

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### 4.1. Identification

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Each TTM 01-E unit is shipped with an identification label on the side of the case. The label provides details of the particular options fitted to the unit, the power supply requirement, the serial number and firmware revision.

- Check the identification label on the side of the unit to ensure that the correct model has been supplied before proceeding to install!

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### 4.2. Product Registration

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Register your TTM 01-E at [www.tekroninternational.com/register](http://www.tekroninternational.com/register) to receive firmware upgrade notifications, customer resources access, and more.

### 4.3. Packing list

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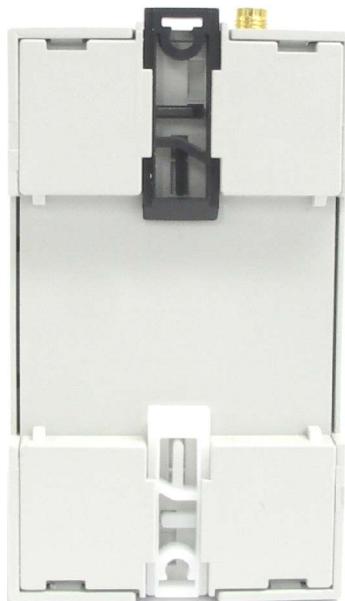
Each TTM 01-E kit is shipped with the following:

- TTM 01-E Time Code Generator
- GPS Antenna optimized for stationary applications, with mounting plinth
- Antenna lead-in cable fitted with matching connectors
- CAT5e Ethernet cable
- Configuration Software
- User Manual – this document

### 4.4. Mounting the TTM 01-E

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The clock is designed to be mounted to a standard din rail mount using the supplied clips on the base. The clips can also be used to screw mount the unit.

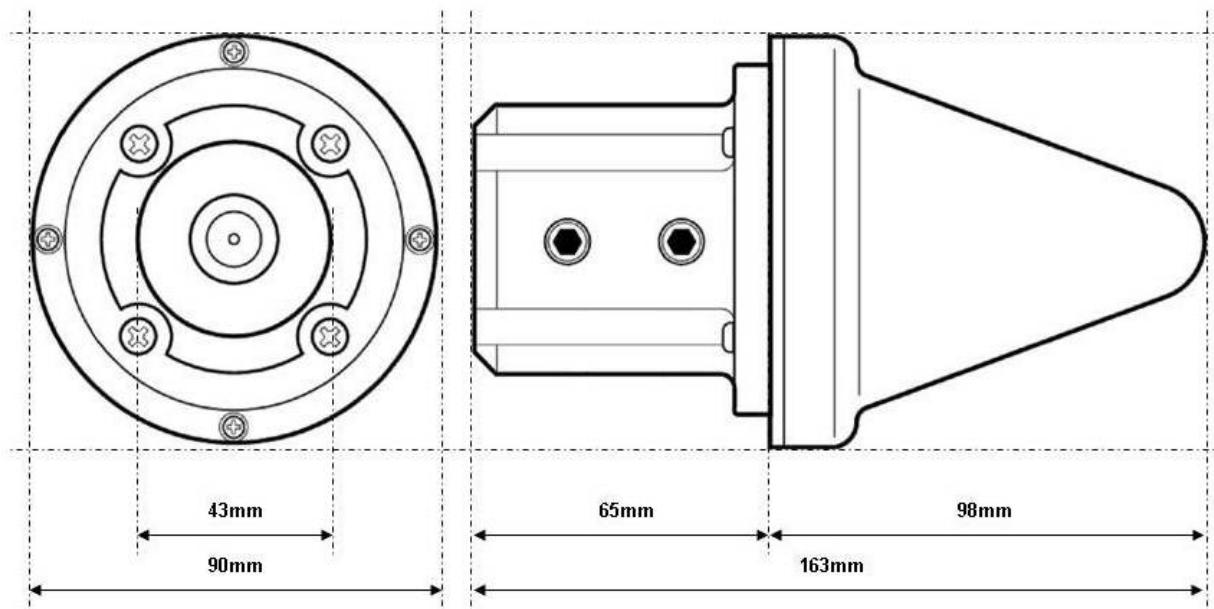


## 4.5. GPS Antenna and Cable Installation

### 4.5.1. GPS Antenna

#### NAIS GPS Antenna

The TTM 01-E unit's standard shipping configuration includes an active GPS antenna radome specifically designed for industrial/static timing environments, together with a pipe-mounting plinth. The mechanical diagram below shows the radome and pipe mounting plinth attached. Refer to Appendix A.1 for the complete antenna specifications.



The antenna pipe-mounting plinth is designed to fit over the top of a pipe like a capping. The mount has an internal diameter of 43mm, to fit a pipe with external diameter of between 40 and 42mm (1½ inch/32mm nominal ID galvanized pipe). The top end of the pipe should be cut flat, so that the rubber gasket inside the antenna mount sits flush against it, forming an effective weather seal. The mount is fixed to the pipe with two stainless steel M8 hexagon-socket setscrews (supplied).

#### Available Accessories

Antenna Cable

Adjustable Antenna Mounting Bracket

Lightning Protection Kit

In-line Amplifier

## Pre-installation

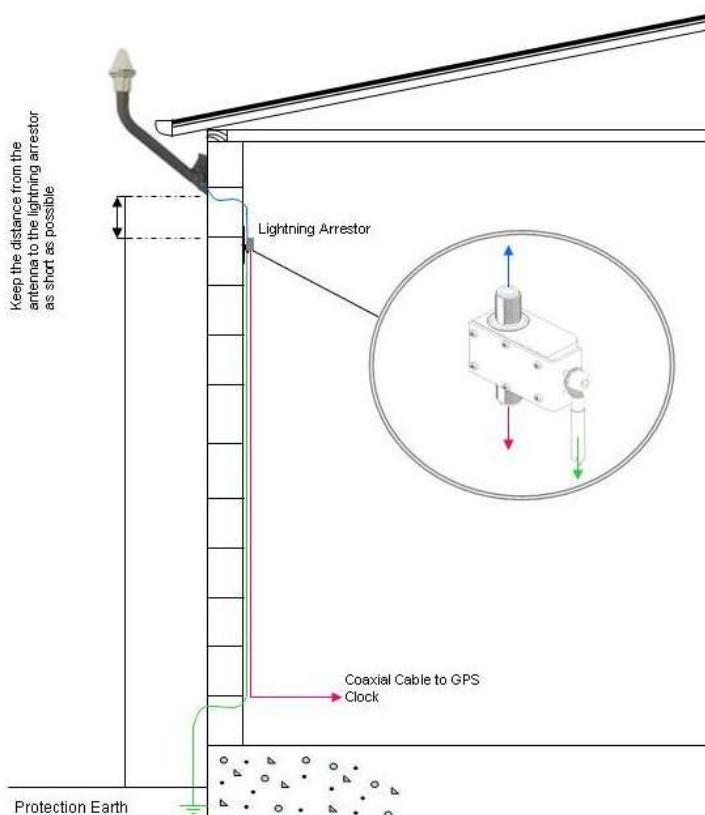
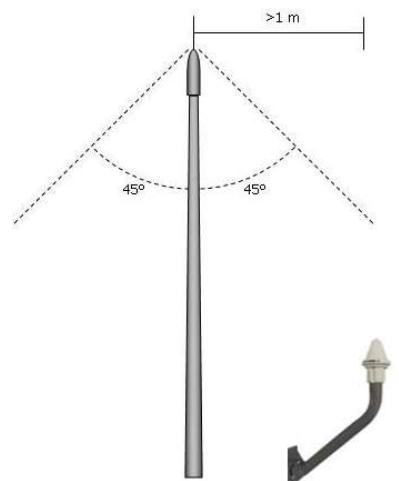
### GPS Antenna placement

The GPS antenna should always be installed in a position where it has a clear view of the satellites in the sky. When surveying a site prior to installation, consider any fixed or moving obstructions which may affect GPS reception (E.g. Terrain, Pylons, mobile obstructions...). Avoid close proximity to antennas from other services where possible. The antenna has excellent rejection characteristics to out-of-band signals, as does the GPS receiver, but high-powered RF signals in close proximity to the antenna may swamp the very low-level signals from the GPS satellites.

### Reducing the risk of Lightning Strike

The first line of protection against the effects of lightning-induced surge events involves positioning the antenna in a “lightning-protected zone”. In practice, this means ensuring that there is at least one other earth-bonded structure located in the same rooftop area (e.g. another antenna, or a lightning rod) that reaches significantly higher than the top of the GPS antenna. The GPS Antenna should then be mounted so that it lies within a 45-degree angle from the top of the other earth-bonded structure. The GPS antenna mount itself should also be securely bonded directly to the building protection earth – and not connected via any of the other earthing structures.

By following the directions above you will reduce the risk of lightning strike. However, there is no fail-safe way of preventing lightning strike. A lightning arrestor should be installed to reduce the risk of damage caused in this instance.



### Lightning Protection

At installations where lightning frequently occurs a lightning arrestor should be installed between the antenna and clock. Tektron's antenna lightning protection kit LPK 01 provides additional protection through the use of an impulse suppressor. In the event of a lightning derived high voltage surge occurring, the impulse suppressor activates, short-circuiting the cable directly to earth.

For the lightning protector to be effective, it must be firmly mounted to a conductive metal surface that is itself bonded to the building protective earth. Ensure that a good electrical connection is made between the surge protector and the earthing system. All earthing connections should be as short as possible, should have no sharp bends or loops. The preferred mounting position is on the inside of the building's exterior wall, adjacent to the antenna lead entry point.

### Antenna Mounting Bracket

The antenna pipe-mounting plinth is designed to fit over the top of a user-supplied pipe like a capping. Source a pipe that has an external diameter of between 40 and 42mm (1½ inch/32mm nominal ID galvanized pipe). The top end of the pipe should be cut flat, so that the rubber gasket inside the antenna mount sits flush against it, forming an effective weather seal.

# [www.tekroninternational.com](http://www.tekroninternational.com)

Establish the mounting method for the pipe, such as strapping or bolting to a frame on the edge of the building, or strapping to an air conditioning exhaust or similar. The base of the pipe needs to be accessible for the cable entry, if this is not practical, then a hole or slot can be made in the side of the pipe to allow the cable to enter and be passed up to the top of the pipe.

An adjustable antenna mounting bracket can be procured from Tekron at the time of ordering. Refer to appendix A.2 for specifications.

## **Cable Installation**

Tekron GPS Clocks can be ordered with 15, 30, or 60 meters of high performance RF cable factory-fitted with a TNC-type male connector at one end, and a SMA male connector at the other. The TNC-type connector mates with the connector on the antenna and provides a robust and weather-resistant connection. The smaller SMA connector mates with the connector on the GPS clock rear panel and is only fractionally larger in diameter than the cable itself; this facilitates installation in conduit and through small apertures.

Custom lengths can be ordered upon request however additional costs may apply.

Where antenna cable distances exceed 60 meters, lower loss (e.g. LMR400UF) cables can be used or alternately, an in-line amplifier can be installed. Refer to Tekron for further advice.

While the cable shielding is excellent, the cable should not be routed in close proximity to power cables or other RF cables carrying transmitter signals – in particular, parallel runs are to be avoided if possible. If such runs are absolutely unavoidable, a minimum separation of 30cm may be used as a guideline.

The GPS receiver has excellent out of band rejection characteristics, as does the antenna itself. However, sound engineering practice should not rely on these factors alone to guarantee performance. Careful installation will enhance the long-term reliability and on-going stability of the Time Code Generator.

The absolute minimum bend radius for the antenna cable supplied is 40mm, but it is preferable to use a larger radius if possible. Caution should be taken at all times during the installation of the cable to avoid crushing or shorting the cable.

## **GPS Antenna Installation**

The antenna cable is passed up through the pipe from the bottom end, through the mounting plinth, and connects directly to the TNC connector on the base of the antenna. It is advisable to wrap self-amalgamating tape around the connector to seal the connection and provide protection against moisture ingress. Fastened the antenna to the mounting plinth using the four stainless screws supplied with the kit, and then the complete antenna assembly can be placed on the pipe and secured by tightening the grub screws on the side of the plinth with the supplied Hex key.

## In Summary

1. Install the GPS antenna in a position where it has a clear view of the sky, away from RF transmitters, and in a lightning protected zone.
2. Establish a mounting method and procure a suitable mounting pipe.
3. Feed the antenna cable through the bottom of the pipe until it protrudes from the top.
4. Feed the cable through the antenna mounting plinth and connect to the TNC connector on the base of the antenna radome, ensuring the TNC-connector is not cross-threaded. Finger tight is sufficient. Do not over-tighten! Seal the connector with self-amalgamating tape.
5. Align and fasten the mounting plinth to the radome using the four stainless steel mounting screws supplied.
6. Place the antenna and mount assembly, complete with the cable attached, squarely over the top of the mounting pipe, allowing excess cable to fall back through the pipe. Secure the antenna mount with the two setscrews, ensuring that the antenna assembly remains firmly pressed against the end of the pipe, thus providing the exterior weather seal. Secure the now complete antenna assembly and pipe to the previously prepared mounting structure.

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 All TTM 01-E antenna installations should follow the guidelines above.

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## 4.6. Operation

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 The label on the side of TTM 01-E contains the voltage rating: DO NOT apply power outside of this rating!

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Connect the antenna lead and the antenna (with a good view of the sky). Then connect the power source to the power input terminals on the base of the unit. The polarity of the power connection is unimportant.



The time required to achieve tracking and synchronization (given a good “view” of the sky) is typically within a minute. Reactivating a unit that previously has been synchronized 1000’s of km away from the present position will take longer, but not more than 45 minutes.

 Care should be taken to ensure that the connector is not cross-threaded when attaching the antenna lead-in cable. The connector should be tightened firmly by hand only. Do NOT over-tighten!

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## 5.CONFIGURATION SOFTWARE

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Configuration software is provided on a CD with all TTM 01-E units. This software is compatible with Windows 2000, XP, NT, and Vista PC's.

The TTM 01-E can be configured over a Local Area Network (LAN) or by direct connection via crossover cable. Sections 5.1 and 5.2 describe the two connection methods to enable configuration.

### 5.1. Connection via LAN

---

Run the supplied CD and locate the configuration software, which is in [Drive] “\TTM01E\TTM01E.exe”. This software may be run directly from the CD or be copied to a local folder. [Drive] is typically D::.

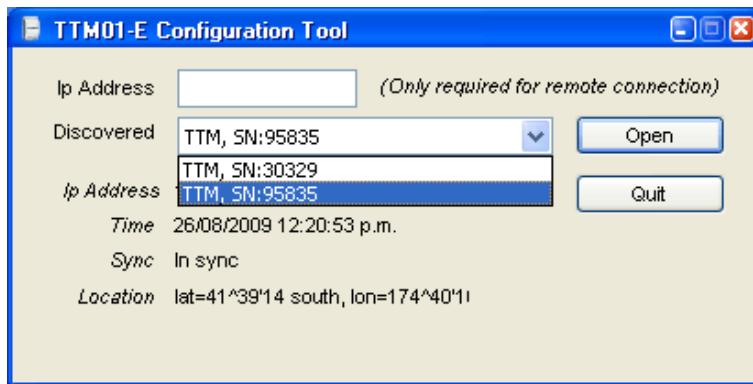
Apply power to TTM 01-E and connect the unit to a network switch located on the LAN using the supplied 2m CAT5e Ethernet cable. Using a PC connected to the LAN, run the configuration software program TTM01E.exe. The configuration software will use DHCP addressing to find any TTM 01-E units connected to the LAN.

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- IP addresses do not need to be preset.

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The window below will appear showing the serial numbers of all TTM 01-E units found on the LAN. Select the serial no of the unit you would like to configure and click open.

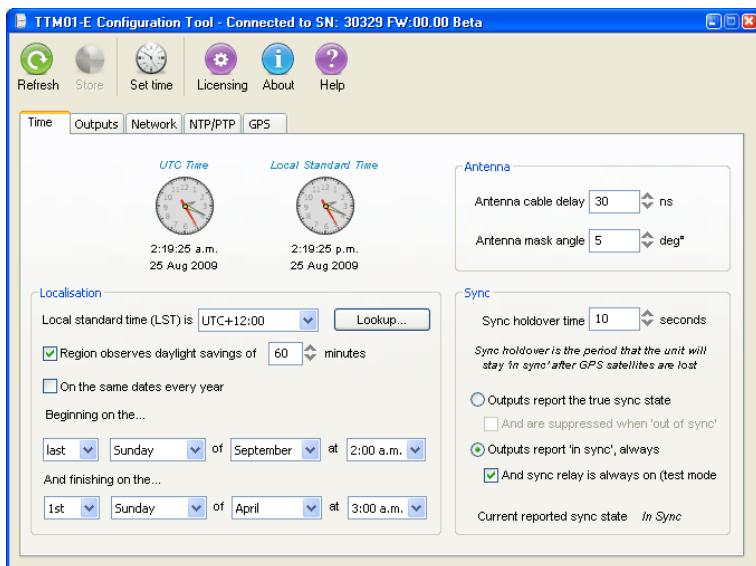


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- If no TTM 01-E units are found on the Network and you are confident that the TTM 01 is connected properly, check the Windows firewall settings on your PC to ensure that the programme is not being blocked.

---

After a successful connection, a snapshot of the current clock settings is shown on the “Time” tab.



## 5.2. Direct connection method

Run the supplied CD and locate the configuration software, which is in [Drive] “\TTM01E\TTM01E.exe”. This software may be run directly from the CD or be copied to a local folder. [Drive] is typically D:.

Apply power to TTM 01-E and connect the unit via an Ethernet crossover cable to a PC and run the configuration software program TTM01E.exe. As in the case of connection via a LAN, a window will appear showing the serial number of the TTM 01-E unit connected. Select the serial no of the unit and click open.

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- If the TTM 01-E unit's serial number does not appear, check the Windows firewall settings on your PC to ensure that the programme is not being blocked.

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## 6.CONFIGURING THE TTM 01-E

### 6.1. Time Tab

#### 6.1.1. Localization Section

##### Local Standard Time (LST)

The time offsets define the number of hours (and, in rare cases, minutes) that the local time differs from UTC time. A positive offset means that the local time is ahead of UTC.

##### Lookup...

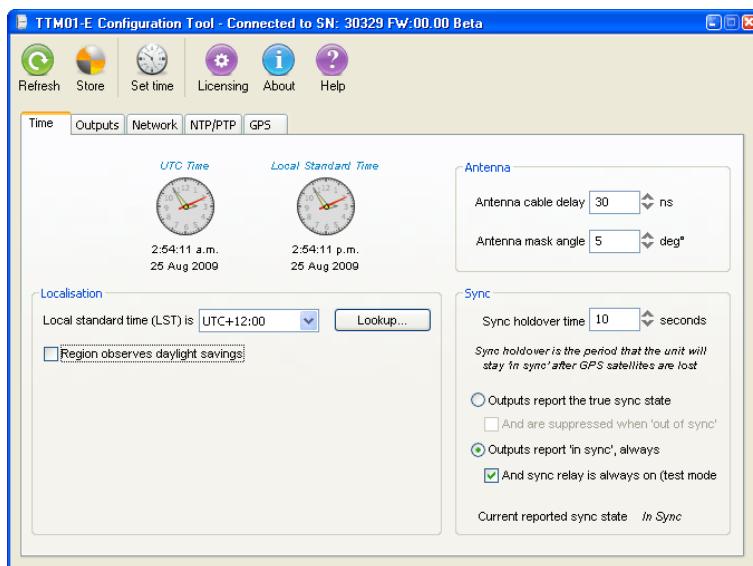
The “Lookup...” button provides a convenient way of automatically filling in time offset and daylight savings parameters simply by selecting a geographical location. Note: this information is derived from “Windows™”, so should be verified as correct before use.

##### Region observes daylight savings

Selecting this option allows the TTM 01-E to be configured to make daylight savings changes automatically.

Further options are then made available including:

- DST (Daylight Savings Time) offset in reference to LST (Local Standard Time).
- Fixed date/ or fixed rule for calculating a date method



#### 6.1.2. Antenna

##### Antenna Cable Delay

All antenna systems introduce signal delay (depending on the cable length). Optimize the timing accuracy of the output signals by entering the appropriate value in this field (4ns per meter of antenna cable). E.g. for a 30 meter antenna cable, enter “120”

##### Antenna Mask Angle

This is the elevation above the horizon below which satellites will not be used in time and position calculations. A good starting value is 5 degrees, but this may need to be increased in areas with land based obstacles to prevent time quality loss due to multipathing effects. Increasing this value may reduce the number of satellites in view.

### 6.1.3. Sync

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#### Sync Holdover Time

The “Sync Holdover Time” parameter is used to control the period after loss of satellite sync that will be tolerated before TTM 01-E will show the loss of sync status, indicating an alarm state. Correct installation will make the loss of sync event rare; although in areas with poor GPS coverage there may be occasions where tracking is momentarily lost. The “sync holdover” feature is used to mask these effects.

The accuracy of all outputs when there is a complete satellite “blackout” is maintained to within a few micro-seconds over short periods (a few minutes), and to within 200 $\mu$ s for up to 40 minutes. A single satellite signal sufficiently recovers accuracy to within 1 $\mu$ s.

---

 In typical SCADA operations, time syncing to within 0.5ms is considered adequate. Setting Sync Hold to the maximum (2550 seconds) will prevent “loss of sync” alarms in the event that satellites are temporarily obstructed.

---

#### Outputs report the true sync state

Under normal conditions this option should be selected. The clock reports the true state of synchronization to the connected IEDs.

#### *And are suppressed when “out of Sync”*

When this option is selected, the clock will not output any time sync signals unless it is synced to one or more satellites.

#### Outputs report “in sync” always

The clock will output time sync signals as if it were synced to GPS, even if this is not true (e.g. there is no antenna attached). In this mode the sync indication outputs will be active at all times.

---

 “Outputs report ‘in sync’ always” is typically used for testing in laboratory environments and should NEVER be used in time critical environments.

---

#### *And sync relay is always on*

The sync indication outputs are always active indicating the clock is in sync, even if this is not true.

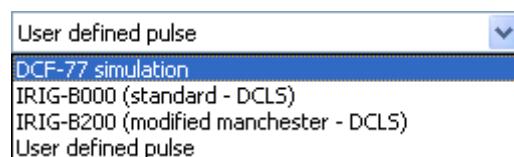
## 6.2. Outputs Tab

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### 6.2.1. Programmable Outputs

---

TTM 01-E GPS Clocks with order codes beginning with T2-Sxxx or T2-Txxx; can be configured to output one of four different output waveforms. Selection between the four options is done via a drop-down menu. The options available for each output are:



- DCF-77 simulation
- IRIG-B000 (standard DCLS)
- IRIG-B200 (Modified Manchester –DCLS)
- User defined pulse

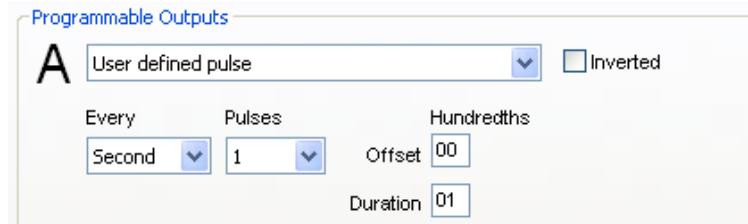
Each of the programmable outputs can also be inverted in its operation.

---

 TTM 01-E GPS Clocks beginning with T2-Axxx only output modulated IRIG-B (B120) time codes.

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In the case of the User-Defined Pulse option being selected for any outputs, further parameters are entered to define the pulse sequence. The parameters are as follows:



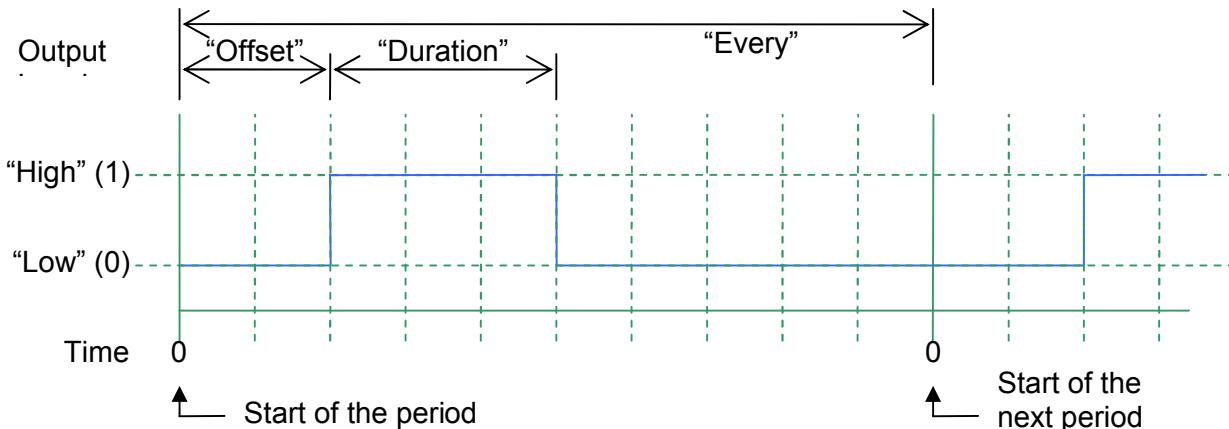
Drop-down menus allows the user to choose to have pulses output every “second”, “minute”, “hour”, or “day”. Specify the frequency of pulses under the “Every” and “Pulses” fields: Use online help or press “F1” while over the pulses area to get a list of the available values that can be entered into the “Pulses” box. The table below shows the valid number of pulses per second which can be configured:

Period “Every”	Number of “Pulses”
Second	1, 2, 3, 4, 10, 20, 50, 1000
Minute	1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30
Hour	1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30
Day	1, 2, 3, 4, 6, 8, 12

Specify the “Offset” this is the period after the start of a new day, hour, minute, or second to the start of the pulse.

Specify the “Duration”; this is the time the pulse stays asserted.

Check “inverted” to swap the polarity of the pulse – that is “High” and “Low” levels are swapped.



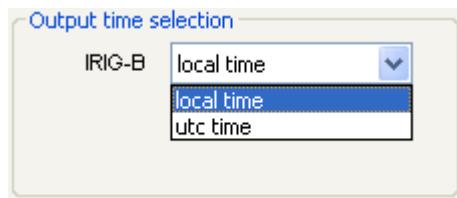
## 6.2.2. Serial Strings

On serial equipped units (T1-Sxxx), serial strings are selected by using a single drop down list in the “Outputs” Tab.

Refer to Appendix B for definitions of all the serial strings supported.

### 6.2.3. Output time selection

This option allows the user to output local time or UTC time over the IRIG-B outputs.



### 6.2.4. IRIG-B Options

In the “Output Config” page:

Checking the “Binary seconds in IRIG-B code” field adds binary encoded seconds of day information to the IRIG-B code.

Checking the “IEEE1344” or “AFNOR” extensions adds AFNOR S87-500 or IEEE1344 extensions to the IRIG-B code.

### 6.2.5. IEEE1344 and AFNOR Extensions

The IRIG-B time code provides time of day and day of year data. The latest version of the standard “IRIG 200-04” also includes year information. The IEEE1344 extensions add data relating to local time and the quality of the time signal.

Extension name	Extra information contained:	Origin
IEEE1344	Year, impending leap second info, local time offset specification, impending daylight savings change, time-quality	US
AFNOR NFS 87-500	Year, day of year, day of week, month, day of month.	European

Only one of IEEE1344 or AFNOR NFS 87-500 may be on at any time, most equipment that comes from the US will use the IEEE1344 extensions.

## 6.3. Network Tab

### 6.3.1. Network configuration

If your network supports DHCP the TTM 01-E can obtain IP Address settings automatically. Otherwise; you need to ask your network administrator for the appropriate IP setting.

#### IP Configuration

Networks that include a DHCP server offer automatic address allocation via **Dynamic Host Configuration Protocol**. (DHCP). The time server will automatically operate within a DHCP environment to fetch a dynamic address if it does not already have a fixed address configured.

#### Host IP Address

Set to your desired IP address.

#### Netmask

Set to 255.255.255.0 for a standard class c network.

#### Gateway

Refer to the network administrator.

### 6.3.2. Simple Network Management Protocol (SNMP) and Syslog reporting

---

#### Report low satellites

This setting defines the minimum number of satellites which must be visible. If the number of GPS Satellites drops below this threshold, a SNMP message “low satellites” is generated. As TTM 01-Es true clock accuracy when tracking just a single satellite is at least two orders of magnitude better than what can be practically handled on the network, the default value of “1” is sufficient for detection of this condition. The default setting of units shipped is “1”.

#### SNMP community name

The default value is “public”. This may be changed to suit the specific SNMP architecture on the network if required. If SNMP is not implemented for other purposes on the network, then the “public” setting allows the use of a simple SNMP trap display utility running on a remote monitoring PC to display the status messages sent from the NTS.

#### SNMP trap destination

This parameter allows for up to five destination IP addresses to be entered. Machines on any or all of these IP addresses can then receive the status messages from the NTS unit. Even if there is no formal SNMP system running on the network, the messages can be received and displayed on the destination machines running “Windows NT” or higher using the freeware utility “SNMPTRAP.EXE” which is on the CD supplied with the TTM 01-E kit.

#### Syslog local file

Normally you would set to zero unless further categorizations of the syslog messages are required.

#### Syslog destination

One or two IP addresses may be entered to define destination machines running system logs.

## 6.4. NTP/ PTP Tab

---

This tab is inactive unless the NTP/SNTP or NTP/SNTP and PTP are ordered at the time of purchase.

A license may be purchased at a later time and entered into the licensing section of the configuration software to activate these options.



#### NTP

---

#### Compatibility

##### ***Do not respond when unsynced***

Selecting this option causes the time server not to respond to time synch request unless synchronized to satellites.

#### Broadcasts

##### ***Send Broadcasts***

If this option is selected, the unit prompts for a poll interval. The unit will then broadcast time packets at the interval specified.

##### ***Send Multicasts***

If this option is selected, the unit prompts for a poll interval and Multicast Group IP. The unit will then broadcast time packets at the interval specified to the multicast group specified.

## Security

### Use MD5 Authentication

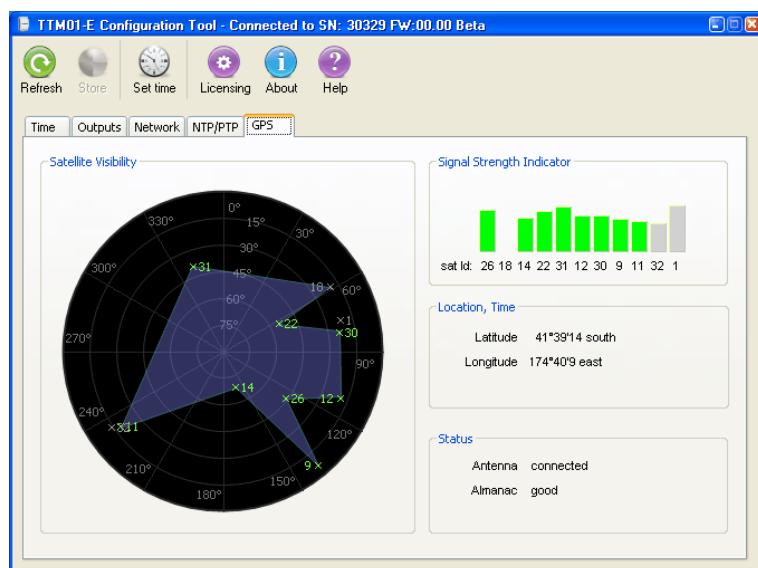
The TTM 01-E supports fully encrypted requests. If this option is selected, the unit then prompts for five ASCII or Hex keys.

## 6.5. GPS Tab

The information in the “GPS” tab helps with troubleshooting and optimizing an antenna installation.

### 6.5.1. Satellite Visibility

Visible satellites are shown on a polar-display. The rings mark the 'elevation' and the sectors mark 'azimuth'. The centre of the display represents directly overhead and the elevation is 90° at this point. The edge of the display, elevation = 0°, represents the horizon. The 'azimuth' is a compass direction where 0° represents true north, 90° is east and 180° is south. Satellites being used are marked by a colored cross on the display, and a blue bar on the Satellite Signal Strength Indicator, otherwise it is gray on both.



### 6.5.2. Signal Strength Indicator

The signal strength indicator gives real-time information regarding the signal reception from GPS satellites.

- Green bars indicate good satellite reception
- Orange bars indicate poor reception

### 6.5.3. Location

This shows the latitude and longitude of the installation.

### 6.5.4. Status

This shows the Antenna and Almanac status.

## 6.6. Test Mode



When the antenna is disconnected, the time can be arbitrarily set using the Set Time button. This function allows the TTM 01-E to be used as a signal source for testing the ability of externally attached equipment to correctly process received time codes through unusual time transitions such as the 28/29 Feb rollover during leap years, or daylight savings transitions.

The TTM 01-E would normally be configured with “**Outputs report “in sync” always**” and “**And sync relay is always on**” settings activated when arbitrarily setting the time.

## 7. FACTORY HARDWARE OPTIONS

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### 7.1. Power Supply Options

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This table shows the three different power supply configurations that may be ordered with TTM 01-E.

Designator	DC Input Range
L (Low)	12 to 36 Vdc,
M (Medium)	20 to 72 Vdc
H (High)	90 to 300 Vdc

### 7.2. Lightning Protection Option

---

A lightning Protection kit may be fitted into the antenna lead-in cable. The kit contains a protection device, two coaxial cable connectors, a connector crimp tool, and mounting hardware. Refer to Appendix A.6 for specifications.

#### 7.2.1. LPK01 Kit Contents

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Quantity	Description
1	Polyphasor DGXZ+06NFNF-A Impulse Suppressor
2	N-type Male Crimp Style Coaxial cable connector set to match antenna cable
1	Crimp Tool to match the above connectors (RG59)
1	Roll Self-amalgamating Insulation tape

## 8.FIRMWARE UPGRADE INSTRUCTIONS

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Download the file "ttm01e\_firmware\_vxxxx.exe" from the customer resources section on the Tekron International website. You will need a username and password which will have been issued when the TTM 01-E was registered. If the product has not been registered, it can be registered at: [www.tekroninternational.com/register](http://www.tekroninternational.com/register). If you would like to be notified when new firmware is available, or if you would like to obtain access for further personnel, contact Tekron at [support@tekroninternational.com](mailto:support@tekroninternational.com).

Once the firmware is downloaded; connect your PC to a network switch in the same subnet as the TTM 01-E unit which requires upgrade and follow the directions below..

---

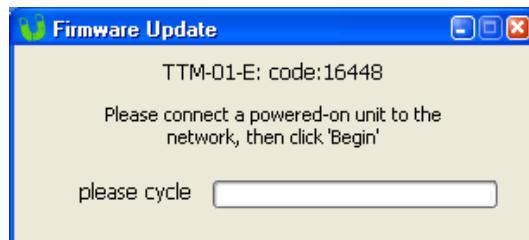
- To confirm that the TTM 01-E and PC have a good connection, run the configuration software and verify that the TTM 01-E can be seen on the network. Once this is confirmed, close the configuration software. Never upgrade the firmware with the configuration software running.

---

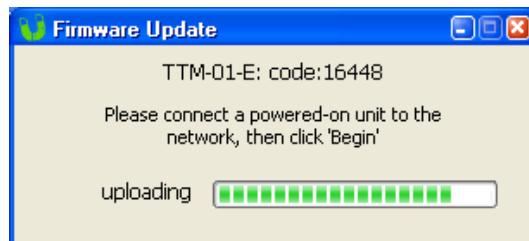
- 1 Run the ttm01e\_firmware\_vxxxx.exe programme and click begin.



- 2 Recycle (i.e. turn off and then on) the power to the TTM 01 unit being upgraded.



- 3 The firmware will then update...



And once complete press ok and exit the programme.



## APPENDIX A SPECIFICATIONS

### A.1. GPS Antenna

#### Physical Specifications

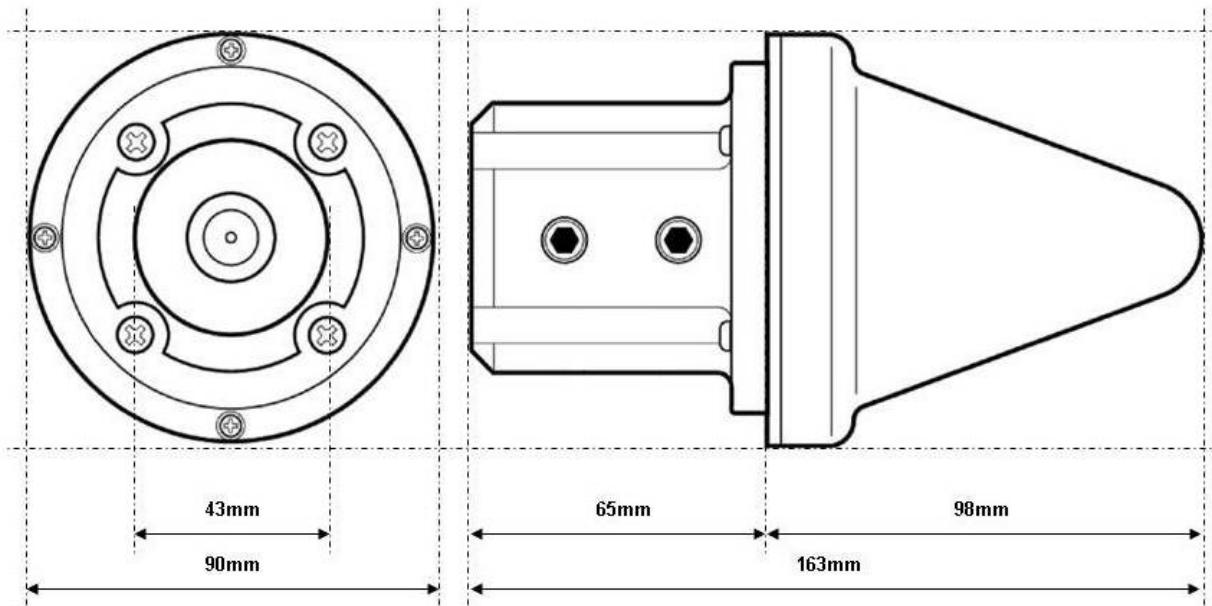
Dimensions	Diameter	90 mm
	Height	98 mm (without connector or plinth)
Weight		200 g

#### Environmental Specifications

Operating Temperature Range	-40 to +85° C
-----------------------------	---------------

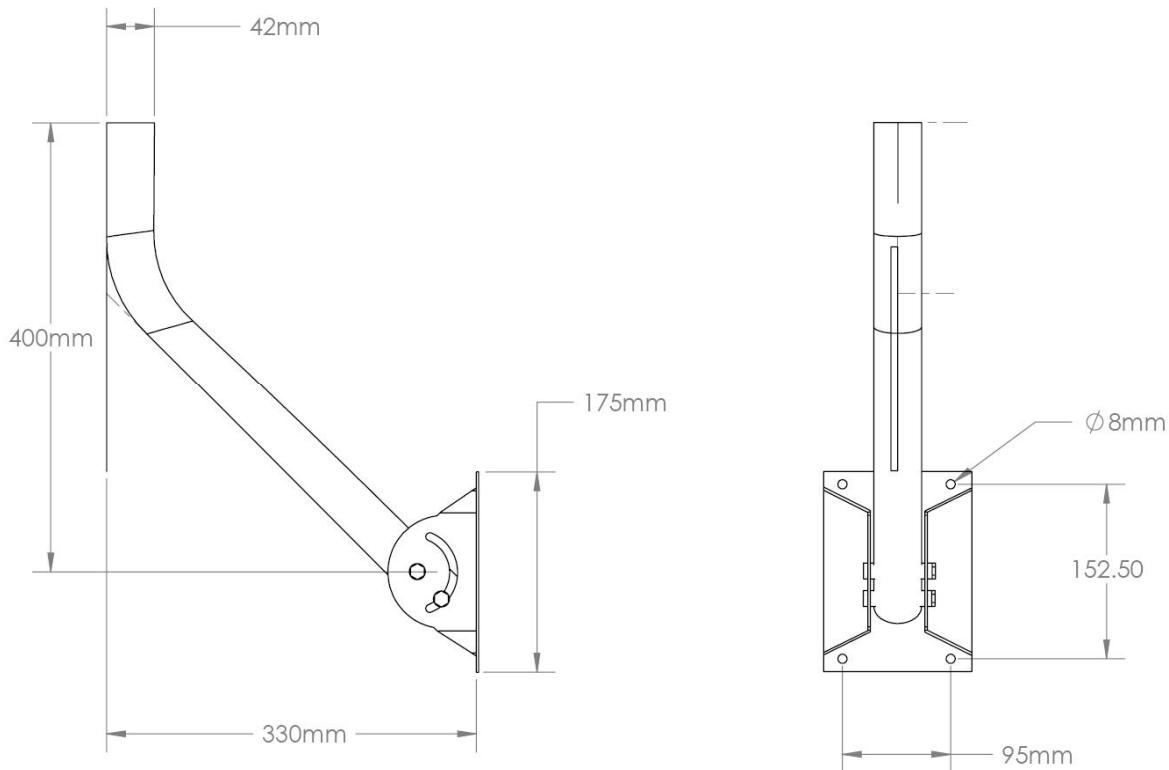
#### Electrical Specifications

Polarisation	Right hand circular polarisation
Bandwidth	1575.42 MHz ± 1.023 MHz
Power Supply	5 V dc ± 0.5 V
Current Drain	20 mA Typical 27 mA Maximum
Total Gain	38 dBi Typical 30 dBi at 90° elevation
Attenuation	60 dB at 1525 MHz, 1625 MHz (± 50 MHz on centre frequency)
Output VWSR	1.5 Typical
Output VWSR	2.5 Maximum
Lightning Protection	80 V for IEC1000-4-5 standard



## A.2. Adjustable Antenna Mounting Bracket

The steel adjustable antenna mounting bracket will assist in the dissipation of energy should the antenna be struck by lightning. The mounting bracket should be securely bonded directly to the building protection earth – and not connected via any of the other earthed structures.



### A.3. Antenna Cable

---

The TTM 01-E can be ordered with 15, 30, or 60 meters of high performance LMR240 cable factory-fitted with a TNC-type male connector at one end, and a SMA male connector at the other. The TNC-type connector mates with the connector on the antenna and provides a robust and weather-resistant connection. The smaller SMA connector mates with the connector on the TTM 01-E and is only fractionally larger in diameter than the cable itself; this facilitates installation in conduit and through small apertures.

Custom lengths can be ordered upon request (Additional charges may occur)

Where antenna cable distances exceed 60 meters, LMR400 can be used, or an in-line amplifier can be installed. Refer to Tekron for further advice.

#### Environmental Specifications

---

Operating Temperature Range	-40 to +85° C
-----------------------------	---------------

#### Electrical Specifications

---

Attenuation (1575.42MHz)	38.9 dB/ 100 m
Velocity of Propagation	84 %
Dielectric Constant	1.42 NA
Time Delay	3.97 nS/m
Impedance	50 Ω
Capacitance	79.4 pF/m
Inductance	0.20 uH/m
Shielding Effectiveness	>90 dB
DC Resistance Inner Conductor	14.1 Ω/1km
DC Resistance Outer Conductor	12.8 Ω/1km
Voltage Withstand	1500 VDC
Jacket Spark	5000 V RMS
Peak Power	5.6 kW

#### A.4. TTM 01-E Unit

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##### Physical Specifications

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Dimensions	Width	55 mm
	Depth	60 mm
	Height	90 mm
Weight		150 g

##### GPS Receiver

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L1 (1575.42 MHz) Frequency, C/A Code, 12-Channel, parallel-tracking receiver.

Position Accuracy	Horizontal	<9 m (90%)
	Altitude	<18 m (90%)
Timing Accuracy		<60 ns to UTC
Acquisition	Reacquisition	<2s (90%)
	Hot Start	<3s (90%)
	Warm Start	<35s (90%)
	Cold Start	<38s (90%)
Sensitivity	Acquisition	-146dBm
	Tracking	-160dBm
Voltage		2.7 – 3.6 Vdc

##### Oscillator Specifications

---

Stability (Freewheeling stability, following tuning from at least 4 or more GPS satellites for at least 30 minutes.)  $5 \text{ parts in } 10^8$

##### Input and Output Specifications

---

Type	Electrical	Physical	Accuracy at the port
<b>AM IRIG-B Version</b>			
AM IRIG-B (modulated)	9V		$\leq 2 \mu\text{s}$ of UTC
<b>TTL Version</b>			
TTL	5V		$\leq 200 \text{ ns}$ of UTC
<b>Serial Version</b>			
RS232			$\leq 1.5 \mu\text{s}$ of UTC
NTP/ SNTP		RJ45	$\leq 200 \text{ ns}$ of UTC

##### Environmental Specifications

---

Operating Temperature Range  $-10 \text{ to } +65^\circ \text{ C}$

##### Electrical Specifications

---

Power Supply	Low Voltage	12-36 Vdc
	Medium Voltage	20-72 Vdc
	High Voltage	90-300 Vdc
Power drain		6 W max

## A.5. In-line Amplifier

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The Raven LA Series inline amplifier, filters and amplifies GPS signals to extend cable runs hundreds of feet.

### Physical:

---

Length	95 mm (approximately)
Diameter	163 mm
Weight	420 g
Connector type	N-Type Female (Both ends)

### Electrical Specifications

---

Power Consumption	8 mA
Input Voltage	3 to 8 Vdc
Operating Current	< 10 mA typical
Noise Figure	< 4 dB typical

### Environmental:

---

Operating Temperature	-55 to 45° C
-----------------------	--------------

## A.6. Lightning Protection Kit

The Polyphaser GX™ Series has separate circuits for RF-path protection and DC pass protection. This “extra” - filtering allows us to provide the lowest let through voltage in the industry. The GX™ Series is the protector to which all others are compared, and is the standard protector for GPS and tower mounted equipment.

### Physical Specifications

Property	Metric
Dimensions	Width
	93 mm
	Depth
	72 mm
	Height
	36 mm
Weight	200 g
Connector type	N-Type Female (Both ends)

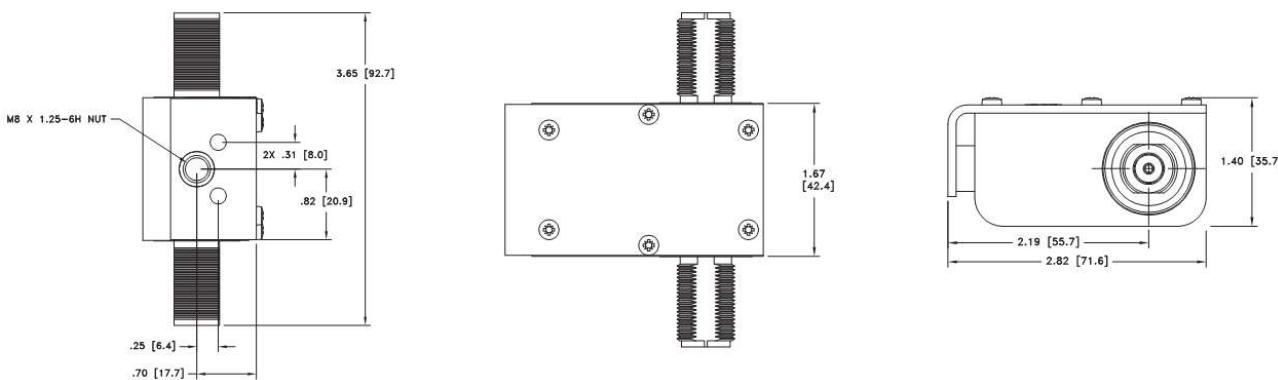
### Electrical Specifications

Operating Voltage	6.5 Vdc
Maximum RF Power (@20°C)	300 W
Frequency	800 – 2500 MHz
Insertion Loss	<0.1 db (Typical)
Return Loss	>26 db
Surge (Max) Multi strike	20 kA @ 8x20 µs (IEC 61000-4-5)
Surge Throughput Energy:	<15 µJ @ 6 Vdc to 610 µJ @ 60 Vdc (4 kV/ 2 kA 8 x 20 µs waveform)
User current	≤4 A

### Environmental:

Relative Humidity	0 to 95%
Vibration	1 G @ 5 Hz to 500 Hz
DC Resistance	<0.1 Ω Typical
Temperature	-50°C to +85°C

Fully weatherized housing meets IEC 60529 IP67  
Meets Bellcore #TA-NWT-00487 (Procedure 4.11)  
wind driven 120 MPH rain intrusion



## APPENDIX B SERIAL OUTPUT STRINGS

### B.1. NGTS Time Code O/P on P4

Timing	Transmitted once per minute. Sent during the last second before the minute rollover to which the data in the string refers
About	Normally used in conjunction with 10mS pulse on P4 pin 1 that finishes precisely on the minute.
Comms Definition	9600bd, 8-bit ASCII, no parity TYYMMWhhmmx<CR><LF> Placeholder Content T "T" YY Last two digits of the year: e.g. "12" = the year 2012 MM Month: "00" = January ... "12" = December W Day of week: "01"=Monday ... "07"=Sunday hh Two digit hour mm Two digit minute x Time mode: "0" = Local time, "1" = UTC time <CR> Carriage Return: HEX 0D <LF> Line Feed: HEX 0A

Example	Interpretation
T020422112340<CR><LF>	Monday 22 April 2002 – 12:34 local time

### B.2. IRIG J-17 Time Code O/P on P4

About	This code is compatible with IRIG Standard 212-00
Timing	Transmitted once every second. The leading edge of the "start" bit of the first character <SOH> is exactly on the second that the message describes.
Comms Definition	9600bd, 7-bit ASCII, odd parity <SOH>DDD:hh:mm:ss<CR><LF> Placeholder Content <SOH> HEX 01 DDD Day of year: range "001"—"365" : hh hour: "00"—"23" mm minute: "00"—"2 ss Seconds: "00"—"59" <CR> HEX 0D <LF> HEX 0A

Example	Interpretation
<SOH>112:12:34:36<CR><LF>	day 112, time 12:34:36

### B.3. String-A Time Code O/P on P4

About	This code is very similar in data content to the IRIG J-17 code, but adds a two-character field containing the year, and uses 8-bit ASCII, no parity data format
Timing	Transmitted once every second. The leading edge of the “start” bit of the first character <SOH> is exactly on the second that the message describes.
Comms	9600bd, 8-bit ASCII, no parity
Definition	<SOH>DDD:hh:mm:ss:YY<CR><LF>
Placeholder	Content
<SOH>	HEX 01
DDD	Day of year: range “001”—“365”
:	HEX 3A
hh	hour: “00”—“23”
mm	minute: “00”—“59”
ss	seconds: “00”—“59”
YY	year: “00”—“99” representing the last two digits of the year
<CR>	HEX 0D
<LF>	HEX 0A

Example	Interpretation
<SOH>112:12:34:36<CR><LF>	day 112, time 12:34:36

### B.4. String-B Time Code O/P on P4

About	This code substitutes a “Quality” indicator byte for the year field, but otherwise is identical in form, function and timing to String-A.
Timing	Transmitted once every second. The leading edge of the “start” bit of the first character <SOH> is exactly on the second that the message describes.
Comms	9600bd, 8-bit ASCII, no parity
Definition	<SOH>DDD:hh:mm:ssQ<CR><LF> Refer to String-A table (above) for the definitions of the common digits:

“Quality” Character (Q)	Meaning	
HEX	ASCII	
20	<Space>	Clock in sync, timing accuracy is better than 60nS
2E	.	(full stop) Clock is accurate to 1µs
2A	*	Clock is accurate to 10µs
23	#	Clock is accurate to 100µs
3F	?	Clock accuracy may be worse than 100µs

Example	Interpretation
<SOH>112:12:34:36?<CR><LF>	day 112, time: 12:34:36, >100µs sync error

## B.5. String-C Time Code O/P on P4

---

About	This code is effectively a combination of String-A and String B. It provides both year information and a sync indicator field.
Timing	Transmitted once every second. The leading edge of the “start” bit of the first character, <CR>, is exactly on the second to which the message data refers.
Comms	9600bd, 8-bit ASCII, no parity
Definition	<CR><LF>Q★YY★DDD★hh★mm★ss.000★★★
Placeholder	Content
<CR><LF>	HEX 0D,0A
Q	Quality indicator: “ ” = in-sync, “?” = out-of-sync
★	HEX 20 (ASCII “ ”)
YY	Year: “00”—“99” representing the last two digits of the year
DDD	Day of year: range “001”—“365”
hh	hour: “00”—“23”
mm	minute: “00”—“59”
ss	seconds: “00”—“59”
.000	ASCII “.000”

---

Example	Interpretation
<CR><LF>? 02 112 12:34:36.000	day 112 of year (20)02, time: 12:34:36, out-of-sync

N.B. in the above example the three trailing spaces as described in the definition are invisible.

## B.6. String-D Time Code O/P on P4

String-D is IDENTICAL in content to String-B, but the second mark is at the leading edge of the start-bit of the (<CR>).

---

Example	Interpretation
<SOH>112:12:34:36?<CR><LF>	day 112, time: 12:34:36, >100µs sync error

## B.7. String-E Time Code O/P on P4

---

About	This provides time, year information, and a sync indicator field.
Timing	The string is transmitted once every second, with the leading edge of the “start” bit of the <CR> exactly on the second.
Comms	9600bd, 8-bit ASCII, no parity
Definition	<SOH>YYY:DDD:hh:mm:ssQ<CR><LF>
Placeholder	Content
<SOH>	HEX 01
YYY	3-digit year, e.g. “012” = 2012
:	HEX 3A
DDD	Day of year: range “001”—“365”
hh	hour: “00”—“23”
mm	minute: “00”—“59”
ss	seconds: “00”—“59”
Q	Quality character, as defined in String-B (above)

---

Example	Interpretation
<SOH>004:112:12:34:36?<CR><LF>	(2)004, day 112, 12:34:36pm, >100µs sync error

## B.8. String-F Time Code O/P on P4

---

Timing	The string is transmitted once every second, with the leading edge of the “start” bit of the first carriage return (<CR>) exactly on the second.
Comms	9600bd, 8-bit ASCII, no parity
Definition	<CR><LF>1100<CR><LF>44hhmmss<CR><LF>54ddd<CR><LF> <CR><LF>45HHMMss<CR><LF>55DDD<CR><LF><BEL>
Placeholder	Content
<CR><LF>	HEX 0D, 0A
1100	ASCII “1100”
44	ASCII “44” (means local time follows)
54	ASCII “54” (means local day of year follows)
45	ASCII “45” (means UTC time follows)
55	ASCII “55” (means UTC day of year follows)
ddd	Local day of year: “001”—“365”
hh	Local hour of day: “00”—“23”
mm	Local minute of day: “00”—“60”
ss	seconds: “00”—“59”
DDD	UTC Day of year: “001”—“365”
HH	UTC hour: “00”—“23”
MM	UTC minute: “00”—“59”
<BEL>	HEX 07

## B.9. NMEA ZDA Time Code O/P on P4

---

About	This string is compatible with and defined by the NMEA-0183 standard
Timing	Transmission is once every second. The leading edge of the “start” bit of the “\$” is exactly on the second.
Comms	9600bd, 8-bit ASCII, no parity
Definition	\$GPZDA,hhmmss.00,DD,MM,YYYY,xx,yy*CC<CR><LF>
Placeholder	Content
\$GPZDA	ASCII “\$GPZDA”
,	ASCII “,” (comma)
hh	UTC hour of day: “00”—“23”
mm	UTC minute of day: “00”—“60”
ss	UTC Seconds: “00”—“59”
.00	ASCII “.00”
DD	UTC day of month: “01”—“31” depending on which month
MM	UTC month: “01”—“12”, “01” = January
YYYY	UTC year, 4 digit.
xx	Local time zone offset from UTC in hours <sup>1</sup>
yy	Local time zone offset from UTC in minutes <sup>1</sup>
*	ASCII “*”
CC	2-digit hex representation of the result of XORing the 8 data bits of each character between, but not including the “\$” and “*”. (00-FF)
<CR><LF>	HEX 0D, 0A

<sup>1</sup>set to zero when UTC time in ASCII string is selected

## B.10. NMEA RMC Time Code O/P on P4

---

About	This string is compatible with and defined by the NMEA-0183 standard
Timing	Transmission is once every second. The leading edge of the “start” bit of the “\$” is exactly on the second.
Comms	9600bd, 8-bit ASCII, no parity
Definition	\$GPRMC, hhmmss.00,a,tt,ttt,n,ggg,gg,gggg,w,0.0,0.0,DDMMYY,0.0,E*CC<CR><LF>
Placeholder	Content
\$GPZDA	ASCII “\$GPRMC”
,	ASCII “,” (comma)
hhmmss	UTC hour of day, minute of day, seconds
.	ASCII “.” (full stop)
0	ASCII “0”
a	Status: “A” = valid, “V” = invalid
tt,tt.ttt	Latitude (degrees, minutes): “00,00.0000”—“89,59.9999”
N	Latitude (north/south): “N” = north, “S” = south
ggg,gg,gggg	Longitude (degrees, minutes): “000,00.0000”—“359,59.9999”
W	Longitude (east/west): “E” = east, “W” = west
DDMMYY	UTC day of month, month, 2-digit year:
E*	ASCII “E”*
CC	2-digit hex representation of the result of XORing the 8 data bits of each character between, but not including the “\$” and “*”.
<CR><LF>	HEX 0D, 0A

## **WARRANTY STATEMENT**

---

Tekron International Ltd (Tekron) warrants for a period of TEN years from the date of shipment that each Product supplied shall be free of defects in material and workmanship. During this period, if the customer experiences difficulty with a product and is unable to resolve the problem by phone with Tekron Technical Support, a Return Material Authorization (RMA) will be issued. Following receipt of an RMA number, the customer is responsible for returning the product to Tekron, freight prepaid. Tekron, upon verification of warranty will, at its option, repair or replace the product in question and return it to the customer, freight prepaid. No services are handled at the customer's site under this warranty.



Tekron shall have no obligation to make repairs, or to cause replacement required through normal wear and tear or necessitated in whole or in part by catastrophe, fault or negligence of the user, improper or unauthorized use of the Product, or use of the Product in such a manner for which it was not designed, or by causes external to the Product, such as, but not limited to, power or failure of building services.

A product will not be warranted if it is an accessory not carrying the Tekron brand name. In this case, warranties are limited to the warranty provided by the original manufacturer of the accessory. Examples of such products and accessories are antennas, cables, etc.

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Warranty claims must be received by Tekron within the applicable warranty period. A replaced product, or part thereof, shall become the property of Tekron and shall be returned to Tekron at the Purchaser's expense.

A return material authorization number issued by Tekron must accompany all return material.

## NOTES

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## WARNING

This product has been designed to comply with the limits for a Class A digital device pursuant to Part 15 of FCC rules. These limits are designed to provide reasonable protection against such interference when operating in a commercial environment.